User's Manual

SMARTDAC+

Model GX10/GP10/GX20/GP20

Log Scale (/LG) User's Manual

vigilantplant®

YOKOGAWA
Yokogawa Electric Corporation

IM 04L51B01-06EN
1st Edition

Introduction

Thank you for purchasing the SMARTDAC+ Series GX10/GX20/GP10/GP20 (hereafter referred to as the GX or GP).
This manual explains the Log scale (/LG option) function of the GX/GP.
Although the display of GX20 is used in this manual, GX10/GP10/GP20 can be operated similarly.
To ensure correct use, please read this manual thoroughly before beginning operation.
For details on other settings, procedures, and communication features, read also the following user's manuals.

- Model GX10/GX20/GP10/GP20 Paperless Recorder User's Manual (IM 04L51B01-01EN)
- Model GX10/GX20/GP10/GP20 Paperless Recorder Communication Command User's Manual (IM 04L51B01-17EN)

Notes

- The contents of this manual are subject to change without prior notice as a result of continuing improvements to the instrument's performance and functions.
- Every effort has been made in the preparation of this manual to ensure the accuracy of its contents. However, should you have any questions or find any errors, please contact your nearest YOKOGAWA dealer.
- Copying or reproducing all or any part of the contents of this manual without the permission of YOKOGAWA is strictly prohibited.

Trademarks

- vigilantplant and SMARTDAC+ are registered trademarks of Yokogawa Electric Corporation.
- Microsoft and Windows are registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries.
- Adobe and Acrobat are registered trademarks or trademarks of Adobe Systems Incorporated.
- Company and product names that appear in this manual are registered trademarks or trademarks of their respective holders.
- The company and product names used in this manual are not accompanied by the registered trademark or trademark symbols (® and ™).

Using Open Source Software

- The TCP/IP software of this product and the document concerning the TCP/IP software have been developed/created by YOKOGAWA based on the BSD Networking Software, Release 1 that has been licensed from University of California.

Revisions

May 2014 1st Edition

1st Edition: May 2014 (YK)
All Right Reserved, Copyright © 2014, Yokogawa Electric Corporation

GX/GP Version Described in This Manual

The contents of this manual correspond to the GX/GP with release number 2 (see the STYLE S number) and style number 1 (see the STYLE H number).

Conventions Used in This Manual

Unit

K	Denotes 1024. Example: 768K (file size)
k	Denotes 1000.

Markings

Improper handling or use can lead to injury to the user or damage to the instrument. This symbol appears on the instrument to indicate that the user must refer to the user's manual for special instructions. The same symbol appears in the corresponding place in the user's manual to identify those instructions. In the manual, the symbol is used in conjunction with the word "WARNING" or "CAUTION."

WARNING Calls attention to actions or conditions that could cause serious or fatal injury to the user, and precautions that can be taken to prevent such occurrences.

CAUTION Calls attention to actions or conditions that could cause light injury to the user or cause damage to the instrument or user's data, and precautions that can be taken to prevent such occurrences.

Note Calls attention to information that is important for the proper operation of the instrument.

Reference Item

▶ Reference to related operation or explanation is indicated after this mark.
Example: ▶ section 4.1

Conventions Used in the Procedural Explanations

Bold characters Denotes key or character strings that appear on the screen.
Example: **Volt**

Aa#1 Indicates the character types that can be used.
A uppercase alphabet, a lowercase alphabet, # symbol, 1 numbers

Procedure
Explanation

Carry out the procedure according to the step numbers. All procedures are written with inexperienced users in mind; depending on the operation, not all steps need to be taken.
Explanation gives information such as limitations related the procedure.

Path
Description

Indicates the setup screen and explains the settings.

Contents

Introduction i
GX/GP Version Described in This Manual ii
Conventions Used in This Manual ii
Using the Log scale Function 1
Log Scale Display Function 1
Restrictions 1
Setting the Log scale 2
AI channel settings 2
Setup Examples 9

Blank

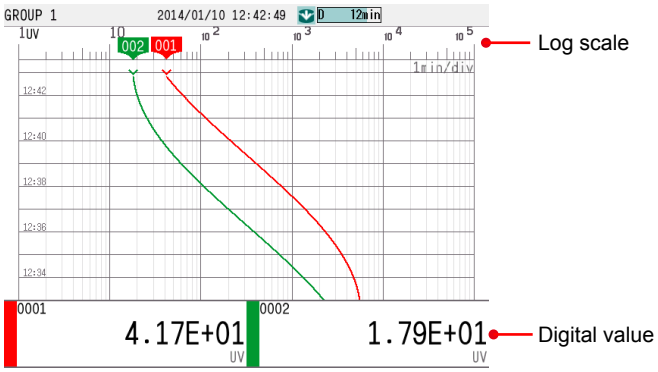
Using the Log scale Function

Log Scale Display Function

You can apply a logarithmic voltage that has been converted from a physical value to the GX/GP, and then use the GX/GP's log scale (logarithmic scale) to display and record the physical value. The GX/GP supports three types of input signals.

- Logarithmic Input
  This is referred to as "Log input". Log input is input in which the voltage corresponds to logarithmic values of physical values.
- Pseudo Log Input
  This is referred to as "Pseud-log input." This input supports pseudo logs.
  A pseudo log signal is a voltage obtained by summing the one's digit of the voltage representing the exponent of the logarithmic data and the decimal digits of the voltage representing the mantissa.
- Input That Is Linear on a Logarithmic Scale
  This is referred to as "Linear-Log input." Linear log input is input in which the voltage values correspond to the logarithmic values of physical values at each decade division (for example, 1×10^2) and in which, within each decade, the voltage values correspond linearly to physical values.

On the trend display, the GX/GP displays waveforms with the log scale. Digital values are displayed as exponents (for example, 1.2E+03).



Restrictions

Partial

You cannot set the partial display on a channel that is set to log scale.

Differential Computation between Channels

If you set the reference channel of a differential computation between channels to a channel that is set to log scale, an error will be returned as the measured result of the differential computation between channels.

Computation Channels (/MT option)

Do not include channels that are set to log scale in a computation channel expression.
If you include these channels, an error will be returned as the measured result.

Report Function (/MT option)

You cannot create reports for channels that are set to log scale. An error will be returned as the result of report computations on channels that are set to log scale.

Manual Sampled Data

For channels that are set to log scale, the data is stored using the "mantissa + exponent" format, the same format as that of digital values on the GX/GP.

Number of Channels Set to Log Scale

Keep the number of channels set to log scale no greater than 300.
When there are many channels set to log scale, log scale processing may not finish within the scan interval and may cause computation data dropouts.

Setting the Log scale

AI channel settings

Log input computation cannot be specified on current (mA) input modules.

Range settings

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **AI channel settings** > **Range**
Web browser: **Config.** tab > **AI channel settings** > **Channel range (display example: 0001-0010)** > **Range**
Hardware configurator: **AI channel settings** > **Channel range (display example: 0001-0010)** > **Range**

Description

Setup Item	Selectable Range or Options	Default Value
First-CH	AI channel	—
Last-CH	AI channel	—

First-CH, Last-CH

Set the target channels. The channels that you can specify appear depending on the module configuration.

Range

Setup Item	Selectable Range or Options	Default Value
Type	Skip, Volt, GS, TC, RTD[1], DI	Volt
Range	See “Range Details.”	See “Range Details.”
Span Lower	Numeric value (depends on the range)	–2.0000
Span Upper	Numeric value (depends on the range)	2.0000
Calculation	Off, Delta, Linear scaling, Square root, Log input, Pseudo-Log input, Linear-Log input	Off

1 Cannot be specified for the electromagnetic relay type (Type suffix code: -T1) analog input module and low withstand voltage relay type (Type suffix code: -L1).

Type

Set the type to **Volt**. You cannot use the log scale display for any other type.

Note

If you are not using an electromagnetic relay type module, set the range type of each channel to **Skip**.

Range

Set the input type range.

Range Details

Type	Range	Selectable Range	Default Value	Notes
Volt	20mV	–20.000 mV to 20.000 mV	2V	
	60mV	–60.00 mV to 60.00 mV		
	200mV	–200.00 mV to 200.00 mV		
	1V	–1.0000 V to 1.0000 V		
	2V	–2.0000 V to 2.0000 V		
	6V	–6.000 V to 6.000 V		
	20V	–20.000 V to 20.000 V		
	50V	–50.00 V to 50.00 V		

Span Lower, Span Upper

Set the input range. The selectable range varies depending on the range setting.
For the selectable ranges, see “Range Details.”

Note

You cannot set the same value to **Span Lower** and **Span Upper**.

Calculation

Set the log scale type to **Log input**, **Pseudo-log input**, or **Linear-log input**.

Scale[1]

Setup Item	Selectable Range or Options	Default Value
Decimal place	1, 2	2
Scale Lower	Log input: 1.00E–15 to 1.00E+14 Linear-Log, Pseudo-Log: 1.00E–15 to 1.00E+15	1.00E+00
Scale Upper	Log input: 1.00E–14 to 1.00E+15 Linear-Log, Pseudo-Log; 1.00E–15 to 1.00E+15	1.00E+15
Unit	Character string (up to 6 characters, Aa#1)	—

1 Appears when the range calculation is set to **Log input**, **Pseudo-log input**, or **Linear-log input**.

Decimal Place

Set the decimal place for scale lower and scale upper.
This value is also applied to the lower and upper limits of the displayed point of color scale band as well as alarm values.

Scale Lower, Scale Upper

Set the Scale Lower and Scale Upper.

- **When Calculation is Log input**

Set the settings so that **Scale Lower** is less than **Scale Upper**.
The mantissas of scale lower and scale upper can be set to different values.

<table>
<tr><th>Mantissa of Scale Lower</th><th>Setting Range</th></tr>
<tr><td>1.00</td><td>1.00E–15 to 1.00E+15. However, the difference between the exponents must be at least 1.
The scale width must be 15 decades or less.
<table>
<tr><td></td><td>Scale Lower</td><td>Scale Upper</td><td>Notes</td></tr>
<tr><td>Example</td><td>1.00E+01</td><td>1.00E+02</td><td></td></tr>
<tr><td>Examples of invalid settings</td><td>1.00E+01</td><td>2.00E+01</td><td>The difference between the exponents is less than 1.</td></tr>
<tr><td></td><td>1.00E–01</td><td>1.00E+15</td><td>The scale width is greater than 15 decades.</td></tr>
</table></td></tr>
<tr><td>A value other than 1.00</td><td>1.01E–15 to 1.00E+15. However, the difference between the exponents must be at least 2.
The scale width must be 15 decades or less.
<table>
<tr><td></td><td>Scale Lower</td><td>Scale Upper</td><td>Notes</td></tr>
<tr><td>Example</td><td>2.00E+01</td><td>1.00E+03</td><td></td></tr>
<tr><td></td><td>2.00E+00</td><td>5.00E+14</td><td></td></tr>
<tr><td>Examples of invalid settings</td><td>2.00E+01</td><td>7.00E+02</td><td>The difference between the exponents is less than 2.</td></tr>
<tr><td></td><td>2.00E–01</td><td>1.00E+15</td><td>The scale width is greater than 15 decades.</td></tr>
<tr><td></td><td>2.00E+03</td><td>2.00E+15</td><td>The upper limit is greater than 1.00E+15.</td></tr>
</table></td></tr>
</table>

- **Pseudo-Log, Linear-Log**

You can set the settings so that Scale Lower is less than Scale Upper or so that Scale Lower is greater than Scale Upper.
The mantissa that you set for Scale Lower is automatically set as the mantissa of Scale Upper.

The scale is referred to as the positive scale or reverse scale depending on the scale value settings.

Scale	Span value (Input voltage)	Scale value
Positive scale	[Span Lower] < [Span Upper]	[Scale Lower] < [Scale Upper]
Reverse scale		[Scale Lower] > [Scale Upper]

Mantissa of Scale Lower	Setting Range
1.00	1.00E–15 to 1.00E+15. However, the difference between the exponents must be at least 1. The scale width must be 15 decades or less.

	Scale Lower	Scale Upper	Notes
Example	1.00E+01	1.00E+02	
	1.00E+15	1.00E+00	
Examples of invalid settings	1.00E–01	1.00E+15	The scale width is greater than 15 decades.

A value other than 1.00: 1.00E–15 to 9.99E+14. However, the difference between the exponents must be at least 1.
The scale width must be 14 decades or less

	Scale Lower	Scale Upper	Notes
Example	1.33E+01	1.33E+02	
	1.33E+00	1.33E+13	
	1.33E+13	1.33E+00	
Examples of invalid settings	1.33E–15	1.33E+00	The scale width is greater than 14 decades.
	1.33E+03	1.33E+15	The upper limit is greater than 9.99E+14.

The scale displayed on the GX/GP is zoomed in until the value that is less than the lower scale limit and whose mantissa is 1.00 and the value that is greater than the upper scale limit and whose mantissa is 1.00 are displayed. See Example 4 under Scale Examples.

Unit

Set the unit.

Moving average

Setup Item	Selectable Range or Options	Default Value
On/Off	Off, On	Off
Count[1]	2 to 100	2

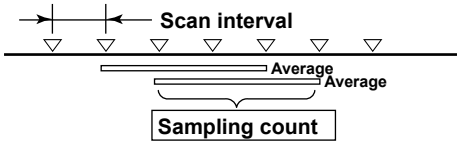
1 Appears when On/Off is set to **On**.

On/Off

Set this to **On** to perform moving average.

Count

Set the number of data points to take the moving average of.

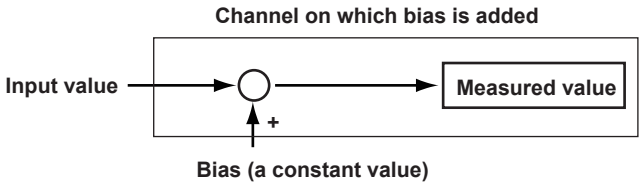


Bias

Setup Item	Selectable Range or Options	Default Value
Value	Numeric value (–999999 to 999999)	0

Value

Set the bias to add to input values or linear scaling values (input calculation).



Scale Examples

Below are scale examples in which the trend direction is set to vertical.

Log input

Example 1

In this example, the mantissa of the scale lower limit and the mantissa of the scale upper limit are both 1.

	Lower	Upper
Span value (Input voltage)	1V	5V
Scale value	1.00E+01	1.00E+04

Example 2

In this example, the mantissa of the scale lower limit and the mantissa of the scale upper limit are both a value other than 1.

	Lower	Upper
Span value (Input voltage)	1V	5V
Scale value	5×1.00E+00	2×1.00E+04

The end points of the scale are displayed using single digits if there is space to display them.

Pseudo-Log input, Linear-Log input

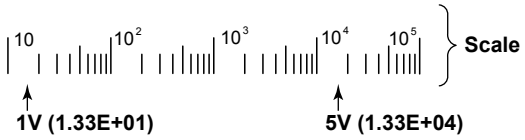
Example 3

Positive scale in which the mantissa of the scale lower limit and the mantissa of the scale upper limits are 1

This is the same as when the mantissa of the scale lower limit and the mantissa of the scale upper limit are both 1 in log input example 1.

Example 4
Positive scale in which the mantissa of the scale lower limit and the mantissa of the scale upper limits are not 1
The scale displayed on the GX/GP is zoomed in until the value that is less than the lower scale limit and whose mantissa is 1.00 and the value that is greater than the upper scale limit and whose mantissa is 1.00 are displayed. Only the scale is zoomed in.
Span Lower equals Scale Lower, and Span Upper equals Scale Upper.

	Lower	Upper
Span value (Input voltage)	1V	5V
Scale value	1.33E+01	1.33E+04
Scale displayed on the GX/GP	1.00E+01	1.00E+05



Example 5
Reverse scale in which the mantissa of the scale lower limit and the mantissa of the scale upper limits are 1
On the reverse scale of a vertical waveform display, the left side is always the minimum scale value and the right side the maximum.

	Lower	Upper
Span value (Input voltage)	1V	5V
Scale value	1.00E+04	1.00E+01

The scale image shows 10^{-1} as 0.1, 10^{0} as 1, and 10^{1} as 10.

Note

Regarding Log Scale Over-range
A value less than –5% of the voltage span is a negative over-range, and a value greater than 105% of the scale is a positive over-range. They are displayed as –Over and +Over. The “Value on over-range” setting (see user’s manual (IM 04L51B01-01EN) section 1.7.2 Setting the Over-range Detection Method) is not applied to channels that are set to log scale.
Example: If the span lower limit is set to 0 V and the span upper limit is set to 10 V, a value less than –0.5 V will result in “–Over” being displayed. A value greater than 10.5 V will result in “+Over” being displayed.

Alarm settings

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **AI channel settings** > **Alarm**
Web browser: **Config.** tab > **AI channel settings** > Channel range (display example: 0001-0010) > **Alarm**
Hardware configurator: **AI channel settings** > Channel range (display example: 0001-0010) > **Alarm**

Description

Setup Item	Selectable Range or Options	Default Value
First-CH	AI channel	—
Last-CH	AI channel	—

First-CH, Last-CH

Set the target channels. The channels that you can specify appear depending on the module configuration.

Level 1, Level 2, Level 3, Level 4

Setup Item	Selectable Range or Options	Default Value
On/Off	Off, On	Off
Type[1]	H: High limit, L: Low limit, T: Delay high limit, t: Delay low limit	H: High limit
Value[1]	Log scale range that corresponds to –5% to 105% of the span width	1.00E+00
Logging[1]	Off, On	On
Output type[1]	Off, Relay[3], Internal switch[4]	Off
Output No.[2]	DO channel or internal switch	—

1 Appears when Level (1 to 4) is set to **On**.
2 Appears when Output type is not set to **Off**.
3 Appears when the range type of any of the DO channels is set to Alarm.
4 Appears when any of the internal switch type is set to Alarm.

On/Off

To use an alarm level (1 to 4), set this to **On**.

Type

Set the alarm type.

Options	Description
H: High limit	An alarm is activated when the measured value is greater than or equal to the alarm value.
L: Low limit	An alarm is activated when the measured value is less than or equal to the alarm value.
T: Delay high limit	An alarm is activated if measured values remain greater than or equal to the alarm value for a specified time period (delay period).
t: Delay low limit	An alarm is activated if measured values remain less than or equal to the alarm value for a specified time period (delay period).

Value

Set the alarm value for the specified alarm type.
The selectable range is the Log scale range that corresponds to –5% to 105% of the span width. The mantissa range is 1.00 to 9.99 or 1.0 to 9.9 (depending on the decimal place setting).
If the alarm value is set outside the selectable scale range of the range setting, the alarm mark will be displayed at the lower or upper limit position of the scale setting.

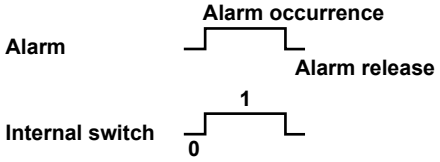
Options	Value	Examples of Alarm Value Range
H, L	Log scale range that corresponds to –5% to 105% of the span width	For 6 V range (span lower: 1.000 V, span upper: 6.000V), LOG input (decimal place: 2, scale lower: 1.00E+01, scale upper: 1.00E+04), 7.08E+00 to 1.41E+04
T, t	Same as H and L	Same as H and L

Logging

Set this **On** to display an alarm (notify you) when an alarm occurs. If set to **Off**, when an alarm occurs, the GX/GP outputs signals to alarm output DO channels or internal switches but does not display the alarm. Alarms are also not recorded in the alarm summary.

Output type

Set the alarm output destination.
Alarm status can be output to the relay (DO channel) or internal switches (100 software switches). Internal switch values are shown below. Like the DO output relay, you can specify AND/OR operation.



Internal switches can be used as events of the event action function (See ▶ User's manual section 1.14, "Configuring the Event Action Function"). In addition, they can also be written in calculation expressions of math channels (/MT option).

Output No.

Set the number of the relay (DO channel) or internal switch to output alarms to.

Note

- The decimal place of the alarm setting is the same as the decimal place of the scale. You cannot specify a value using more than the number of significant digits.
- The alarm hysteresis on channels that are set to log scale is fixed to 0%.
- The “lower and upper limits of available range” shown on the alarm setting screen are guidelines.

Color scale band settings (Display settings)

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **AI channel settings** > **Display settings**
Web browser: **Config.** tab > **AI channel settings** > Channel range (display example: 0001-0010) > **Display settings**
Hardware configurator: **AI channel settings** > Channel range (display example: 0001-0010) > **Display settings**

Description

Color scale band

Setup Item	Selectable Range or Options	Default Value
Band area	Off, In, Out	Off
Color	24 colors (red, green, blue, blue violet, brown, orange, yellow-green, light blue, violet, gray, lime, cyan, dark blue, yellow, light gray, purple, black, pink, light brown, light green, dark gray, olive, dark cyan, and spring green) and a user-defined color (1 color)	—
Display position Lower	Scale lower limit to scale upper limit	1.00E+00
Display position Upper	Scale lower limit to scale upper limit	1.00E+15

Band area

Displays a specified section of the measurement range using a color band on the scale. This setting is shared with the bar graph display.

Options	Description
Off	Disables the function.
In	Displays the area inside using the color band.
Out	Displays the area outside using the color band.

Color

Set the display color.

▶ For instructions on how to set the user-defined color, see User’s manual section 1.2.3, “Setting the Display”.

Display position Lower and Display position Upper

Set a value within the selectable scale range. (The selectable range is 1.00E–15 to 1.00E+15. Set the mantissa to a value in the range of 1.00 to 9.99.

Setup Examples

pseudo-Log input and **Log input** (nonlinear log) setup examples are shown below.

Setting the Pseudo-Log Range

This setting is for logging the pseudo log output (see the table below) of a vacuum gauge.

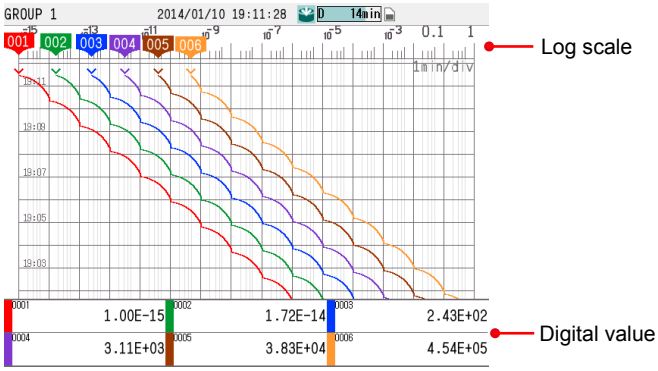
Pressure Reading [Pa]	Output Voltage [V]	Pressure Reading [Pa]	Output Voltage [V]
1.30×10^{-7}	0.13	5.00×10^{-4}	3.50
5.00×10^{-7}	0.50	1.00×10^{-3}	4.10
1.00×10^{-6}	1.10	5.00×10^{-3}	4.50
5.00×10^{-6}	1.50	1.00×10^{-2}	5.10
1.00×10^{-5}	2.10	5.00×10^{-2}	5.50
5.00×10^{-5}	2.50	1.00×10^{-1}	6.10
1.00×10^{-4}	3.10	9.90×10^{-1}	6.99

Press MENU key, Tap the **Brows** tab > **Setting** > **AI channel settings** > **Range**.
Set the channel 0001 range as shown below.

Range
Type: Volt
Range: 20V
Span: Span Lower 0.000, Span Upper 7.000
Calculation: Pseudo-Log input

Scale:
Decimal place: 2
Scale: Scale Lower 1.00E–07, Scale Upper 1.00E+00
Unit: Pa

Display Example



Note

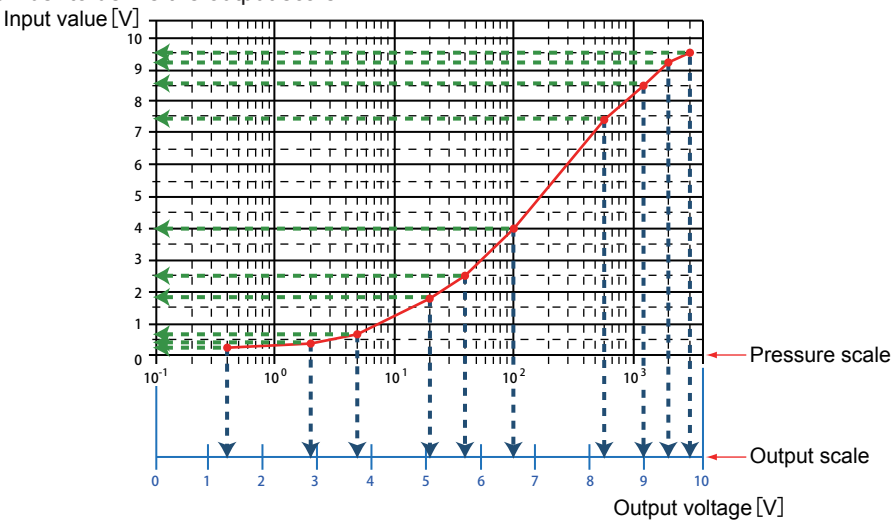
- Set the mantissa to 1.00.
- The output voltage for pressure reading whose mantissa is 1.00 has a certain deviation. For example, if the pressure reading is 1.00E–07, the output voltage is 0.00 to 0.10 V. In this situation, set the range (Span Lower) to the minimum value (0.00 V).

Setting the Log input (Nonlinear Log)

To support the nonlinear output of vacuum gauges, use the calibration correction function to correct the GX/GP input values with linear approximation.

Conceptual Diagram

The pressure scale is mapped to an input scale that has been multiplied by a constant number to derive the output scale.



1 Press **MENU** key, tap **Brows** tab > **Setting** > **AI channel settings** > **Range**.
Set the range of channel 0001 as shown below.

Range
Type: Volt
Range: 20V
Span: Span Lower 0.000, Span Upper 10.000
Calculation: Log input

Scale
Decimal place: 2
Scale: Scale Lower 1.00E–01, Scale Upper 4.00E+03
Unit: Pa

For the span and scale, assign the boundary values of the output scale and pressure scale in the conceptual diagram.

2 Configure calibration correction.

Press **MENU** key, tap **Brows** tab > **Setting** > **AI channel settings** > **Calibration correction**.

Set the range of channel 0001 as shown below.

Mode
Mode: Linearizer Approximation
Number of set points: 10

1 to 10

Set the “Linearizer input” values to the input scale values at the starting points of each line and the “Linearizer output” values to the output scale values at the starting points of each line.

Number of set points	Input value[V]	Output value[V]	Number of set points	Input value[V]	Output value[V]
1	0.25	1.30	6	4.00	6.60
2	0.45	2.80	7	7.48	8.30
3	0.70	3.70	8	8.52	9.00
4	1.80	5.10	9	9.25	9.40
5	2.50	5.70	10	9.50	9.80

Blank